

memorandum

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REPLY TO

ATTN OF: Occupational Safety and Health Policy: Kubicki: 3-4794

SUBJECT: IMPLEMENTATION OF NFPA STANDARD 25

TO: Distribution

The purpose of this memorandum is to provide guidance on the implementation of National Fire Protection Association (NFPA) Standard 25, "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems." This Standard has been in effect since its promulgation in 1992 and has been applicable to the Department of Energy (DOE) through the requirements delineated in DOE 5480.4, "Environmental Protection, Safety and Health Protection Standards," and 5480.7A, "Fire Protection."

The subject guidelines, which are included as Attachment 1, were developed by the DOE Fire Safety Committee based on requests for assistance from both DOE and contractor fire protection representatives and maintenance organizations. This guidance was perceived to be needed to reduce unnecessary costs associated with inspection, testing and maintenance of fire protection systems and to facilitate the application of the Standard to the unique circumstances which characterize the Department.

Neither this memorandum nor the attached guidelines impose new requirements on the Department or its contractors. In fact, the guidance in some instances reflects a relaxation of existing requirements from those delineated in the NFPA Standard. To the extent that this was done, the DOE Fire Safety Committee considered the implications and concluded that implementation of the revised criteria would maintain an acceptable level of safety.

Nothing in these guidelines prevents the development of alternate approaches that will achieve a comparable level of fire protection. These approaches can be implemented based on an "Equivalency" determination as defined by DOE 5480.7A.

If you have any questions, please contact me on 301-903-4794.


Dennis Kubicki, Chairman
DOE Fire Safety Committee

Attachment

IMPLEMENTATION OF NATIONAL FIRE
PROTECTION ASSOCIATION
STANDARD 25, "INSPECTION,
TESTING, AND MAINTENANCE OF
WATER-BASED FIRE PROTECTION
SYSTEMS" AT DEPARTMENT OF ENERGY
FACILITIES

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Introduction and Background

The Department of Energy (DOE), by its choice, complies with the National Fire Protection Association (NFPA) standards, including NFPA 25 on Inspection, Testing, and Maintenance of Water-Based Fire Suppression Systems. The NFPA issued its Standard 25 on February 10, 1992. This document gathered all the inspection, testing, and maintenance requirements for these systems into one standard; previously they were contained in the various design standards for water-based fire suppression systems. The frequencies of many maintenance requirements were increased in the new NFPA 25, and there were many required procedures added.

Prior to the development of and unrelated to NFPA 25, the DOE Richland Operations Office decided to study its maintenance and fire protection system failure rate data to see if there was justification to reduce its costs by not conforming with the NFPA frequencies. A committee of fire protection professionals there found such justification for the Hanford Site, and decided to request that frequencies be reduced for maintenance of 14 specific fire protection systems. They submitted an exemption request to the DOE Office of Environmental Management, which ultimately approved and forwarded it to the DOE Office of Environment, Safety, and Health. The Office of Environment, Safety, and Health approved that request.

The DOE Fire Safety Committee, aware of Richland's action, decided to form some subcommittees at its December 1992 meeting to study some specific problems. One of these was a Programmatic Issues Subcommittee, which was first charged with "developing DOE-wide guidance on implementing NFPA 25, based on the Richland exemption request and a Draft Hanford Site Compliance with NFPA 25 Plan. This is the report of that Subcommittee's work.

A request for a determination of equivalency to NFPA 25 was also submitted by Martin Marietta Energy Systems, Inc. (MMES), to the Oak Ridge Operations Office and to the Office of Environment, Safety, and Health. That request was approved, contingent upon MMES complying with the recommendations of the Programmatic Issues Subcommittee. The Subcommittee examined the MMES proposal in detail, including many instances where differing maintenance frequencies that had been previously recommended existed, and determined appropriate frequencies for maintenance of fire protection systems.

There is a general lack of available data on how previous and existing fire suppression system maintenance requirements were established. Several literature searches and discussions with technical experts in this area failed to reveal definitive research in this area. Failure rate data were obtained from several DOE sites, and some comparisons were made on the effects of changing testing frequencies in particular to see what failure rates would subsequently result. For the case where this was done the failure rates were actually worse at the site with the more frequent testing. In some cases, the best answers the Subcommittee was able to justify were that professional judgement and experience, as used by the NFPA committees in establishing the existing maintenance requirements, had to be used when establishing our own requirements.

General Discussion of Maintenance of Fire Protection Systems

The establishment of maintenance requirements, including the specific maintenance actions needed and the frequencies at which they must be performed, is not an exact science. The goal is to balance the amount of maintenance to maximize system life or reliability against the cost of the maintenance. Theoretically, more frequent maintenance leads to longer life and higher reliability. It also leads to increased costs. Optimization of maintenance frequency might be achieved by performing maintenance at the point where the graphs of frequency of maintenance and system reliability intersect. Some manufacturers do parametric studies of their products or systems to determine the optimum maintenance requirements, but that has not been done for fire protection systems.

Unlike many "systems," there is little "maintenance" which is done to fire suppression systems, on-a routine basis, to increase their performance or prolong their useful life. There is no periodic cleaning done to enhance performance, no lubrication, no planned replacement of parts on a periodic basis, and no measurement of system performance to predict future maintenance needs. Maintenance of fire protection systems consists largely of periodic testing of components, either singly or in a full system test, to verify operation, and periodic inspection to verify system integrity. Fire protection systems are examined visually to ensure that there are no gross misconfigurations or degradation problems which would prevent performance, and that system components are operable, e.g. nozzles and sprinkler heads are not blocked.

There are exceptions. The more "exotic" systems, such as foam-water systems, require chemical testing of the foam. These systems have substantially more moving parts than most fire suppression systems that do require more of what might be considered "maintenance" than do more common fire suppression systems. Additionally, internal combustion engines which drive generators or fire pumps also have more classical maintenance requirements such as periodic replacement of lubricating oils.

The benefit from fire suppression systems maintenance as it is done now is that critical system components which have failed or are near failure are not allowed to remain in that state for long periods of time. Increasing the frequency of maintenance would lessen the time that a component was allowed to remain in a failed state without the knowledge of the systems operators. The study which was done at Hanford documented very low rates of failure of components in large populations of specific maintenance procedures performed. Hanford is continuing to take data to determine if their decreased maintenance frequencies are causing increases in failure rates.

In considering which specific frequencies to recommend for testing of certain components, the Subcommittee tended not to make extreme changes in the length of component operational testing that might significantly increase the time in which failed components remain in service, however.

Method

The Subcommittee met in a face-to-face setting at the Annual DOE/Contractor Fire Protection meeting in Augusta, Georgia, in March of 1993 and the Annual meeting in Albuquerque, New Mexico, in May, 1994. It met numerous other times by teleconference. The Subcommittee discussed each point of the proposed Draft Hanford Site Compliance With NFPA 25 plan, and the currently-approved Oak Ridge maintenance schedule. The issue of the validity of transferring the Hanford or Oak Ridge recommendations generically to all DOE sites was discussed at length. Many hesitations to adopt the existing proposals were based on such questions of validity of the rationale used to justify those proposals as it would be applied to places with differing security and environmental conditions. The question of application of the Subcommittee recommendations to fire suppression systems in nuclear facilities was discussed.

Several literature searches were done. The collection of the Fire Research Information Services at the National Institute of Standards and Technology was searched for research on maintenance and fire protection systems. The DOE Headquarters' Library performed a literature search on the key words "fire protection system" and "maintenance." And the NFPA Library performed a search to try to correlate fire protection systems, maintenance, and system reliability. These efforts turned up little work done on maintenance, and essentially no work done to identify correlation between maintenance of fire protection systems and their reliability.

The Subcommittee's recommendations on maintenance frequencies are included in this report in tabular form, with justifications and footnotes included. The specific deliberations of the Subcommittee are included in its minutes, attached as an appendix to this report. Where appropriate, references are provided.

Subcommittee Philosophy

The Subcommittee used the Draft Hanford Site Compliance With NFPA25 and the Oak Ridge fire protection maintenance plan to consider changes to NFPA25 requirements. The Hanford plan was developed by engineers at the Hanford site in consideration of their failure experience and environmental conditions. The effort put into developing the Hanford plan was very comprehensive, and the Subcommittee did not desire to duplicate it. Likewise, the Oak Ridge frequencies have been used for upwards of 20 years, with acceptable failure rates being experienced. Where there was any question that the basis for the a recommendation may not be generally applicable to DOE sites, the Subcommittee opted to stick with the NFPA 25 frequency.

Many of the maintenance frequencies were not changed, but were caveated with a note for a DOE site to make its own judgement to use the NFPA requirement or to request relief through DOE. These were left that way because of the uncertainties of external environmental influences upon structural integrity of systems and influences upon the performance of some parts, such as strainers. Engineers at DOE sites, which believe that they have justification for changing these maintenance frequencies, should examine the basis for the Hanford changes in maintenance; the intent of the NFPA 25 standard; the

specific performance requirements of their systems; and the specific environmental conditions encountered and their effects on system integrity and performance. Situations thought to justify less frequent maintenance must be referred to the DOE Operations Office through appropriate channels for consideration of an Equivalency as defined by the DOE Fire Protection Order, DOE 5480.7A.

The Subcommittee did not attempt to rigorously define the term "failure." A failure was considered as the specific piece of equipment being inspected or tested not meeting the inspection or test criteria.

DOE Maintenance Management Order, 4330.4A

This DOE Order currently governs the maintenance of DOE facilities. It requires that DOE contractors develop Maintenance Implementation Plans addressing certain specified elements of good maintenance programs and practices. The determination of maintenance procedures and frequencies for nuclear facilities is based on regulatory and code requirements; vendor recommendations; experience at this facility and other facilities; engineering judgement; cost/benefit analysis; available manpower; minimizing personnel radiation exposure using ALARA principles; function, ease of replacement, and demonstrated reliability of the equipment or system; optimizing the equipment or system availability during unit operating conditions; and operating history. (XX - Chapter II, para. 5.3.3) These are the same principles that the Subcommittee used in its deliberations. The Subcommittee believes that its work is compatible with the requirements of this Order.

Nuclear Facilities

Maintenance at DOE nuclear facilities will soon be governed by 10 CFR 830 Part 340. The original draft of this regulation was published in the December 9, 1991, edition of the Federal Register. The major point of this regulation is that a Maintenance and Implementation Plan will be required for nuclear facilities, and that plan will be approved by DOE. The M&IP will contain specifics on which systems in the nuclear facility are covered, what maintenance will be done on those systems, and when that maintenance will be done, among other things. Any deviations from NFPA 25 or other nationally recognized consensus standards for maintenance of systems in nuclear facilities will have to be listed in the Implementation Plan for this nuclear safety rule, to be approved by the Cognizant Secretarial Officer or designee. These deviations will have to be carefully scrutinized and justified. The avenue to do this is clearly through the development and approval of the M&IP.

Conclusions

The Subcommittee reminds all readers of this document that the NFPA 25 requirements are minimum requirements which should not be changed without solid technical rationale. The Subcommittee believes that the rationale used in the development of the maintenance frequencies in this document was sound. This document constitutes a fully DOE-approved equivalent means of complying with the NFPA 25 standard.

Specific Subcommittee Recommendations

The following table lists those specific maintenance, test, or inspection activities from NFPA 25 which the Subcommittee changed or thought that a DOE site might be able to justify change based on their specific environmental circumstances. The Subcommittee recommends that contractors perform trend analysis of failures of their fire protection systems so that a sufficient database will exist in the future to justify equivalences.

Recommended Frequencies Matrix

Note: Only in those instances where a change from NFPA 25 was made; a potentially-justified change was indicated; or a conscientious decision was made to continue with the NFPA 25 frequency, are shown in these tables. The frequencies specified in NFPA 25 should be followed for Category I nuclear facilities or facilities specifically open to the general public, i.e., museums and public auditoriums.

Item	NFPA 25 Reference	NFPA 25 Frequency	Recommended Frequency and Justification
Chapter 2, Sprinkler Systems			
Sprinkler head, Inspection	2-2.1.1	Annually	<p>At same frequency as facility assessment is required, not to exceed three years.</p> <p>This is understood to be on the basis of a floor-level visual examination of a representative sample.</p> <p>These passive components are not prone to failure under normal conditions. It is unlikely that a visual inspection would reveal a condition which would cause failure of a sprinkler head. If systems are exposed to severe environments, this frequency should be re-examined</p>
Spare Sprinkler head, Inspection	2-2.1.2	Monthly	<p>Annually. If a well-maintained stock of spares is kept centrally, the central stock must be inspected annually, but the remote stock does not have to be accounted for.</p> <p>If a stock is kept centrally, and well-maintained, there will be little question that a spare head will be available when needed.</p>

Item	NFPA 25 Reference	NFPA 25 Frequency	Recommended Frequency and Justification
Alarm Device, Inspections	2-2.6	Monthly	Quarterly, Same as NFPA 72 NFPA 72 allows a quarterly visual inspection of the alarm initiating device. If it is acceptable to inspect the electrical portion quarterly, then it should be acceptable to inspect, to the extent possible, the mechanical part quarterly also.
Hydraulic nameplate on sprinkler systems, Inspection	2-2.7	Quarterly	At same frequency as facility assessment is required, not to exceed three years. DOE contractors generally maintain a system of drawings which would permit retrieval of the needed information. There is little chance of tampering with or removal of a hydraulic nameplate in a DOE facility also. See footnote AA.
Waterflow alarms, Test	2-3.3	Quarterly	Quarterly, Unless a site justifies a less frequent activity based on their failure rates and obtains an approved DOE equivalency to NFPA 25.
Gauges, Test	2-3.2	5 years	Note gauge condition during inspection or test, test or replace if abnormality noted.
Sprinkler System Piping, Inspection	2-2.3	Annually	At same frequency as facility assessment is required, not to exceed three years.
Water motor gong, Test	2-3.3	Quarterly	Quarterly, Unless a site justifies a less frequent activity based on their failure rates and obtains an approved DOE equivalency to NFPA 25.

Item	NFPA 25 Reference	NFPA 25 Frequency	Recommended Frequency and Justification
Compressor, Maintenance	2-4.2.1	Per manufacturer	Annually Some manufacturers do not provide specific frequencies for maintenance. Annually was believed to be a reasonable frequency for these devices based on no known failures-presented to the Subcommittee.
Chapter 3, Standpipe and Hose Systems			
Hose Cabinets, Inspection	3.1	Monthly	At same frequency as facility assessment is required, not to exceed three years. There were no known failures of standpipe systems, attributable to the condition of a hose cabinet, discussed in Subcommittee deliberations. The failure of a cabinet would not lead to automatic failure of the system. Because of these factors, an annual inspection was recommended.
Alarm Devices, Test	3.1	Quarterly	Quarterly, Unless a site justifies a less frequent activity based on their failure rates and obtains an approved DOE equivalency to NFPA 25.
Hose Nozzles, " Inspection	Table 3-1, refers user to NFPA 1962 where para. 4-1.2 applies	Annually by NFPA 1962, Monthly by para. 3-2.1 of NFPA 25	At same frequency as facility assessment is required, not to exceed three years. Nozzles are rugged devices, not prone to frequent failure.

Item	NFPA 25 Reference	NFPA 25 Frequency	Recommended Frequency and Justification
Hose Nozzles, Test	Table 3-1, para. 3-2.1	Monthly	As determined to be needed, if a visual inspection reveals abnormalities, or after any-nozzle maintenance. Nozzles are rugged devices.
Hose storage rack, Inspection	Table 3-1, refers user to NFPA 1962, which says nothing	Monthly, per general paragraph 3-2.1	At same frequency as facility assessment is required, not to exceed three years. These are rugged devices, not subject to failures which are so subtle and sudden, that monthly inspections are required.
Hose storage rack, Test	Table 3-1, refers user to NFPA 1962, which says nothing	Monthly, per NFPA 25 general para -2.1	At same frequency as facility assessment is required, not to exceed three years. These are rugged devices, not subject to failures which are so subtle and sudden that monthly inspections are required.
Standpipe systems, Alarm device, Test	3-3.3	Quarterly	Quarterly, Unless a site justifies a less frequent activity based on their failure rates and obtains an approved DOE equivalency to NFPA 25.
Chapter 4, Private Fire Service Mains			
Mainline Strainers, Inspection	4-3.2.3	Annually	Inspection per manufacturers requirements, if used in potable water systems. Annually, if no manufacturer's recommendation or if used in raw water applications.

Item	NFPA 25 Reference	NFPA 25 Frequency	Recommended Frequency and Justification
Hydrants, Dry Mall & Wet, Inspection, Test, & Maintenance	4-3.2.4 4-3.2.5 4-5.3	I - 6mo's T - 1.yr M - 1.yr The valve to the hydrant should be tested to ensure it is fully open.	Annually (combined I, T, M) This is a hydrant flush rather than a quantitative test of the hydrant flow. Hydrants are rugged devices. Large municipal water supply systems generally test these annually. The valve to the hydrant should be tested to ensure it is fully open.
Hose/Hydrant Houses, Inspection	4-3.2.7	Monthly	Annually These are rugged devices, not generally prone to failure.
Chapter 5, Fire Pumps			
Fire pumps Heating system, Inspection	Table 5-2.2	Weekly during heating season	Weekly, during the heating season, if there is no constantly-monitored low temperature alarm. Monthly if the temperature is constantly monitored at an attended location.
Fire pumps, Vent louvers, Inspection	Table 5-2.2	Weekly during heating season	Weekly, during the heating season, if there is no constantly-monitored low temperature alarm. Monthly if the temperature is constantly monitored at unattended location.
Chapter 6, Water Storage Tanks			

Item	NFPA 25 Reference	NFPA 25 Frequency	Recommended Frequency and Justification
Water storage tanks, Water condition (check for ice buildup), Inspection	6-2.1	Daily, during the heating season	<p>Site specific</p> <p>Daily during the heating season unless the water temperature is constantly monitored at an attended location.</p> <p>There were so many variations in frequencies for these inspections, and varying degrees of risk of system failure due to tank freeze-up, that the inspection frequency was tied to freezing risk, water temperature monitoring, and previous freezing experience.</p>
Water storage tanks, Heating system, Inspection	6-2.8	Daily, during the heating season	<p>Site specific</p> <p>Daily during the heating season unless the water temperature is constantly monitored at a attended location.</p> <p>There were so many variations in frequencies for these inspections, and varying degrees of risk of system failure due to tank freeze-up, that the inspection frequency was tied to freezing risk, water temperature monitoring, and previous freezing experience.</p>
Chapter 7, Water Spray Fixed Systems			
Mainline strainers, Inspection and Maintenance, if required	7-4.1.5 k 7-4.9	I - per manufacturer M - 5 years	<p>5 years? Combined I & M,</p> <p>If water is contaminated, the site should use engineering judgement to set an inspection frequency to allow for this condition.</p>

Item	NFPA 25 Reference	NFPA 25 Frequency	Recommended Frequency and Justification
Valve Enclosures, cold weather, Inspection	7-4.1.2	Weekly	See recommended frequencies for valve/fire pump enclosures in Chapters 2, 5, and 9 Recommendations
Pipe & hangars, Inspection	7-4.4	Monthly	Annually These are robust components, not subject to sudden, unknown failures which could not be detected via an annual inspection.
Spray nozzles, Inspection	7-4.5	Monthly	Annually These are robust components, not subject to sudden, unknown failures which could not be detected via an annual inspection.
Individual Nozzle strainers, water spray & foam systems, Inspection & Maintenance	7-4.9 & 8-3.8.1	Annually	Annually, or after each flow test or operation of the system
Drainage, Inspection	7-4.10	Monthly	Annually The presence or lack of adequate drainage will not affect the ability of the system to extinguish fire; it is a secondary effect only, with possible environmental impact. There were no cases of failure of some factor affecting drainage brought to the attention of the Subcommittee.
Chapter 8, Foam-Water Sprinkler Systems			

Item	NFPA 25 Reference	NFPA 25 Frequency	Recommended Frequency and Justification
Foam-water systems Discharge device Location, position, and check for obstruction, Inspection	8-3.4	Monthly	Annually There were no reported cases of discharge devices being moved or obstructed in the foam systems at Oak Ridge. Given that DOE facilities are not generally accessible to the public, particularly not sites where the hazard requires a foam system, an annual basis for this inspection was believed by the Subcommittee to be acceptable.
Foam-water systems, Foam concentrate strainer, Inspection	8-5	Monthly	Annually, for systems using AFFF foam and fresh water Monthly for other foam systems. There were no reported cases of clogging of foam concentrate strainers in DOE AFFF foam systems at Oak Ridge.
Foam-water systems Drainage, Inspection	8-3.9	Monthly	Annually The presence or absence of adequate drainage will not have a direct impact on the system's ability to extinguish fire; it is a secondary effect only, with possible environmental impact. There were no cases of failure of some factor affecting drainage brought to the attention of the Subcommittee.

Item	NFPA 25 Reference	NFPA 25 Frequency	Recommended Frequency and Justification
Foam-water systems, Proportioning systems, Inspection	8-3.10	Monthly	<p>Configuration - Annually for fixed proportioners Monthly for adjustable proportioners</p> <p>Fluid level - Monthly</p> <p>For power systems' strainers - Monthly</p> <p>There were no reported cases of proportioning systems failing. A visual inspection would not necessarily reveal internal problems with a proportioning system.</p>
Foam-water systems, Foam concentrate pump power, Inspection	8-3.10.3	Monthly	Monthly, unless a site justifies a less frequent activity based on their failure rates and obtains an approved DOE equivalency to NFPA 25.
Foam-water systems, Foam concentrate pump running, Maintenance	8-5.4(a)	Monthly	Monthly, unless a site justifies a less frequent activity based on their failure rates and obtains an approved DOE equivalency to NFPA 25.
Foam-water systems Foam concentrate strainer, Inspection & Maintenance	8-3.8.2	Monthly	<p>Annually, for systems using AFFF foam and fresh water Monthly for other foam systems.</p> <p>Maintenance is only done if the strainer is clogged.</p> <p>There were no reported cases of clogging of AFFF foam concentrate strainers in DOE foam systems at Oak Ridge.</p>